REMARKS

Claims 1, 27, 28 and 30-33 are pending. A Sworn Declaration of Yuichiro Shindo, the inventor of the present invention, is filed herewith and provides objective statements relative to the critical natural concerning Zr content in the claimed sputtering target and thin film of the present invention relative to the prior art of record. Based on these statements, Applicant respectfully submits that the claims of the present application are patentable over the prior art of record and that the present application is in condition for allowance.

I. Claim Rejections - 35 USC §103(a)

A. In the non-final Office Action dated March 2, 2009, claims 1, 27, 28 and 30-33 are rejected under 35 USC §103(a) as being obvious over U.S. Patent Application Publication No. 2003/0062261 A1 of Shindo.

Independent claims 1, 30 and 32 of the present application are directed to a hafnium sputtering target or a hafnium thin film produced via sputtering deposition of the sputtering target. The claims of the present application require an extremely reduced zirconium content of 1 to 1000wtppm.

The second paragraph on page 1 of the present application teaches that "hafnium and zirconium are very similar in terms of atomic structure and chemical property" and that the inclusion of zirconium in hafnium has never been acknowledged as a problem. The prior art '261 Shindo publication provides evidence of this sentiment and states:

> " ... a large quantity of zirconium is contained in hafnium, and notwithstanding the fact that the separation and refinement between the two is difficult, **this may be disregarded since the purpose of use of the respective materials will not hinder overall purpose hereof**" (see Paragraph No. 0061 of the '261 Shindo published application);
>
> and

> "It is extremely difficult to reduce Zr in high purity hafnium … the fact that Zr is mixed in high-purity hafnium **will not aggravate the properties of semiconductors, and will not be a problem**." (See Paragraph No. 0065 of the '261 Shindo published application).

Accordingly, the teaching of the cited prior art reference is that Zr content in a highly pure hafnium material is irrelevant since the Zr content "will not aggravate the properties of semiconductors", "will not be a problem", "may be disregarded", and "will not hinder overall purpose".

However, Applicant respectfully submits that reducing Zr content in highly pure hafnium is critical relative to the stability of electronic components and provides an unexpected result in view of the above statements of the above referenced prior art reference. For example, see page 2, lines 14-19, of the present application, as filed, which states:

> "… in recent years, deposition on electronic components using hafnium silicide is being demanded. In such a case, even zirconium content is an impurity, and there is a possibility that the required characteristics of the hafnium raw material may become unstable."

It should be noted that a technique for forming hafnium silicide is to deposit a thin film of hafnium on silicon and then heat the combination to form a thin film of hafnium silicide.

The prior art '261 Shindo published application provides Zr contents reduced to 5,000wtppm, 3,500wtppm or 2,400wtppm in high-purity hafnium, and this presence of Zr is clearly not expected to aggravate the properties of semiconductors as taught by the '261 Shindo published application. Thus, it is clearly unexpected to one of ordinary skill in the art following the teachings of the '261 Shindo published application that the presence of Zr at levels of 5,000wtppm, 3,500wtppm and 2,400wtppm will cause a hafnium silicide film of an electronic component to become unstable. However, as stated directly in the specification of the present application, as filed, this is not true for all electronic components and stability can be an issue.

Thus, Applicant respectfully submits that a Zr content of 1 to 1000wtppm as required by the claims of the present application is critical and provides an unexpected result relative to the teachings provided to one of ordinary skill in the art by the '261 Shindo published application.

Further, the Sworn Declaration of Yuichiro Shindo provides objective statements with respect to the '261 Shindo published application (referred to as D1 in the Sworn Declaration and as corresponding U.S. Patent No. 6,861,030 B2). For instance, the Sworn Declaration provides a technical explanation of why Zr content of 1 to 1000wtppm cannot be achieved for a highly pure hafnium material following the teachings of the prior art reference.

The Sworn Declaration states that the prior art method is "unable to intentionally eliminate" either Hf or Zr as impurities. The stated reason for this is that "both elements are homologous elements and have very similar physical properties." Accordingly, it is stated that "it is extremely difficult to separate and refine Hf and Zr only with fluoric acid cleaning and electron beam melting" as taught by the '261 Shindo application publication.

As stated on the last paragraph of page one of the Sworn Declaration, the inventor oversaw additional testing of high-purity hafnium with a Zr content of 1 to 1000wtppm (such as 600wtppm, 700wtppm, etc.). This material was subjected to the method disclosed by the '261 Shindo application publication (acid cleaning and electron beam melting) and the results of the test were that the Zr content in the high purity hafnium material "did not change" (i.e., had no effect on Zr content when Zr content is at this reduced level). The Declaration states that "there is hardly any difference in the vapor pressure at the temperature during the EB melting" and that therefore, "it would be impossible for only Zr to decrease based on EB melting".

Further, with respect to the reduction of Zr content disclosed by the '261 Shindo application publication from 25,000ppm to 3,500ppm, the Sworn Declaration states that "this is a

result of Zr that was adhered to the surface being eliminated due to acid cleansing". Thus, only the Zr adhered to the surface of a hafnium sponge material can be removed according to the acid cleansing of the prior art. The remaining 3,500ppm or 2,400ppm cannot be removed by the acid cleansing or EB melting steps disclosed by the '261 Shindo application publication. Thus, it would not be possible or expected for the Zr content to be capable of being reduced to 1 to 1,000ppm and the '261 Shindo application publication provides no motivation for limiting Zr content much below that of about 5,000wtppm.

As stated on page 2 of the Sworn Declaration, the unexpected result of the present invention is that by reducing Zr content to the levels required by the claims of the present application, this will "stabilize the characteristics of the electronic components employing Hf" and that "as a result of using the high purity sputtering target ... characteristics of the semiconductor thin film formed from hafnium silicide or the like can be stably maintained". This is entirely unexpected relative to the teachings of the '261 Shindo application publication which states that Zr content included in Hf "will not aggravate the properties of semiconductors" and is not a problem.

Accordingly, although the '261 Shindo application publication discloses a high-purity hafnium having a zirconium content of 0.5wt% (5000ppm) "or less", it only reduces Zr content by subjecting a hafnium sponge material to acid cleansing. This only removes Zr that is adhered on the surface of the hafnium sponge and therefore has its limits. For example, the cited reference teaches that raw material hafnium will have about 25000wtppm of zirconium (see Paragraph Nos. 0088 and 0126 of the '261 Shindo published application) and that the hafnium can be refined such that zirconium content is reduced to 3500wtppm or 2400wtppm (0.24wt%) (see Paragraph Nos. 0089, 0095 and 0131 of the '261 Shindo published application). As stated

in the Sworn Declaration, reduction beyond 3,500ppm and 2,400ppm is "impossible" by aeid cleansing and the reference clearly provides a teaching to one of ordinary skill in the art that this amount of Zr content (5,000wtppm, 3,500wtppm, and 2,400wtppm) can be "disregarded", "will not hinder overall purpose", "will not aggravate the properties of semiconductors", and "will not be a problem".

In contrast, the claims of the present application require reduction of Zr content to 1 to 1000wtppm. This reduction is critical to prevent a hafnium silicide film (formed via use of the high purity hafnium sputtering target) of an electronic component from becoming "unstable". This result is completely unexpected to one of ordinary skill in the art following the teachings of the '261 Shindo published application which teaches that Zr content at a level of 5,000ppm, 3,500ppm or 2,400ppm can be "disregarded", "will not hinder overall purpose", "will not aggravate the properties of semiconductors", and "will not be a problem".

Accordingly, Applicant respectfully submits that a Zr content of 1 to 1000wtppm provides an unobvious and patentable difference between the disclosure and teachings of the '261 Shindo application publication and the subject matter required by the independent claims of the present application. For at least this reason, Applicant respectfully requests reconsideration and removal of the above referenced rejection of claims 1, 27, 28 and 30-33 of the present application.

B. *In the non-final Office Action dated March 2, 2009, claims 1, 27, 28 and 30-33 are rejected under 35 USC §103(a) as being obvious over the publication in the ASM Handbook of Murray titled "Preparation and Characterization of Pure Metals" U.S. Patent Application Publication No. 2003/0062261 A1 of Shindo.*

With respect to the interpretation of the disclosure provided by Murray, Applicant respectfully requests reconsideration for the following reasons.

In the Office Action, it is states that "Murray discloses a purified Hf sample with very high purity in Table 2". Applicant respectfully submits that the Examiner has misinterpreted the subject matter that is disclosed in Table 2 of Murray and requests reconsideration.

On the right hand column of page 1097 of Murray, it is stated that "resistance ratios of zone-refined metals are listed in Table 1." Close inspection of Table 1 of Murray shows that hafnium is **not** included in the list of metal samples. See Table 1 on page 1095 of Murray. In addition, Table 1 includes the following statement: "**See Table 2 for impurity contents of these samples.**" Further, page 1097 of Murray also states that the "corresponding chemical compositions" of the zone-refined metal samples identified in Table 1 "are listed in Table 2". Accordingly, it is clear that Table 2 merely discloses the amount of impurities in the zone-refined metal samples of Table 1 and that Table 1 provides no sample for hafnium.

Upon close inspection of Table 2, the left hand column has the heading "Impurity element". Thus, the listing of "Hf" in the left hand column is as an "impurity element" that is contained in each of the zone-refined metal samples identified in Table 1 which are listed horizontally across the top row of Table 2. Thus, the listing of "Hf" in Table 2 is not as a "purified Hf sample". Accordingly, when the subject matter contained in Table 2 is properly interpreted, Table 2 indicates that the Zr zone-refined metal sample listed in Table 1 includes 40ppm of Hf as an impurity element. Table 2 of Murray clearly does not disclose a "purified Hf

sample" having a "measured Zr content of 40ppm". Applicant respectfully requests reconsideration of the contents of Table 2 of Murray for this reason.

Further, the Office Action states that the "purified Hf sample" has 6N purity. Applicant fails to see such a teaching provided by Murray specifically with respect to a hafnium sample. Accordingly, Applicant respectfully requests reconsideration of Murray with respect to 6N purity of a "purified Hf sample".

For the above reasons, Applicant respectfully submits that when the disclosure provided by Murray is properly interpreted and when the arguments stated above with respect to the '261 Shindo published application are taken into consideration, it is clear that claims 1, 27, 28 and 30-33 are not obvious over Murray in view of the '261 Shindo application publication and are patentable. Applicant respectfully requests reconsideration and removal of the rejection.

II. Conclusion

In view of the above amendments and remarks, Applicant respectfully submits that the claim rejections have been overcome and that the present application is in condition for allowance. Thus, a favorable action on the merits is therefore requested.

Please charge any deficiency or credit any overpayment for entering this Amendment to our deposit account no. 08-3040.

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